

Syllabus - 16:830:637 - Seminar in Cognition

Digital Biomarkers for Brain Sciences:

(Intelligent Behavioral Analyses - iBA)

Fall Semester 2020

Instructor Information

Instructor

Elizabeth B Torres

Email

ebtorres@psych.rutgers.edu

Office Location & Hours

Online

Class: Online

Note: This course satisfies graduate level requirements

Pre-Requisite: Statistics and Psych 533

Index Number 20191

General Information

Description

This class will teach you about a new approach to connect multiple layers of the nervous systems with cognition, while objectively measuring natural behaviors. The class will be 'hands on', meaning that you will bring your own research data and we will use it to provide sample analytical pipelines and to create figures visualizing your work. We will examine various experimental assays and new data collection techniques to deploy the study of human behaviors remotely. We will also use translational methods for Personalized Medicine and Smart Health concepts, compatible with telemedicine today.

Expectations and Goals

The main goal of the class is to introduce you to new technological advances bound to change the ways in which we do behavioral and cognitive sciences, with applications to clinical problems. We will work in teams and the teams will present to the class what they have learned in class. They will explain the uses they envision for the material in their current and future careers.

Course Materials

Recommended Materials

- Recommended Textbook and Readings

Optional Materials

- Matlab software on personal laptop
-

Textbook

Objective Biometric Methods for the Diagnosis and Treatment of Nervous System Disorders 1st Edition (Elsevier) electronic version or paper book, Companion Website with code and sample figures is included with the book. Author Elizabeth B Torres, PhD

Digital Biomarkers for Basic Science and Clinical Use

Week	Topic	Reading	Exercises
General Notion of Behavior and How to Measure it Objectively			
Week 1	What is behavior? How is it currently measured in science and in clinical settings? How can we measure it at home?	TBA	Submit a brief report from a Google Search on these questions
Week 2	The wearable sensors revolution in Precision Medicine: Rethinking the Medical Field	TBA	Let us plot some natural movements' kinematics together
Week 3	The Emergence of Cognitive Systems: From Neonates to Comma States	Chapter 1	Short essay on human agency, volition, and its consequences for neuromotor control
Measuring Agency from Nervous Systems to Society			
Week 4	Rethinking the Mirror Neurons Systems Theory: Understanding the Emergence of Social Cognition	Chapter 2	Short essay on Mirror Neurons Systems Today vs. in its initial stages. Analyses of face data from webcams.
Week 5	Building the notion of agency and self-determination in Autism and Beyond	Chapter 3	Group Discussion on the literature on agency and action ownership
Week 6	Avoiding the Skinner Box While Surviving Rewards and Decisions: Privacy Issues in our Society	Chapter 3	Experimental assays to study agency. Data collection and analyses "do it yourself at home"
Sensory Consequences of Deliberate vs Spontaneous Actions and Decisions			
Week 7	Introduction to the notion of manifolds, distances, geometric invariants, example from motor control and robotics: What are the ingredients to build an autonomous agent		
Week 8	Cognitive Invariants Derived from Self-Generated Motions: Biomarkers of Sensory Preferences	Chapter 4	Connecting Biorhythmic spike data to cortical spikes trains: bridging movement and cognition

Digital Biomarkers for Basic Science and Clinical Use

Week	Topic	Reading	Exercises
Week 9	Sports, The Performing Arts through individual and group performances	Chapter 5	Modeling dyadic interactions through network connectivity analyses: Complex social behaviors
Week 10			Team Presentations
Week 11			Team Presentations
Week 12			Team Presentations

New Dynamic Diagnoses and Outcome Measures of Treatment Effectiveness

Week13	Rethinking Diagnosis Across the Human Lifespan: Age-dependent Lifelong Biomarkers	Chapter 6	Short essay on existing models of clinical diagnoses based on cognitive criteria (Goggle it!)
Week14	Treatment Outcomes Done Differently: The Era of Wearables Revolution	Chapter 6	Examples of digitizing traditional clinical inventories in Autism, Parkinson's disease and the Dementias
Week15	New Concept for Clinical Trials: Biopharma and Academia	Chapter 7	Potential Jobs in Academia and Industry vs. Entrepreneurship
Week16	Closing the Feedback Loops in Real Time: From Brain-Machine to Body-Machine Interfaces	Readings TBA	Brief Essay summarizing the literature discussed in class

Exams and Grades

Date	Subject
Weeks 10-12	Presentations by teams covering material of their choice from Weeks 1-9
Final	Term paper about class-content or content of choice

Additional Information and Resources

Attendance and Grade's Breakdown

Attendance is mandatory as the participation in class will count towards 20% of the grade.

Grades will be broken down as follows:

20% Attendance (5% attendance of recordings with sensors in class; 5% in-class quizzes; 5% participation; 5% leading discussion)

30% Coding exercises in class

40% Presentations in class

10% Final term paper

Grades

Grades will follow the standard scale: A = 89.5-100; B+ = 84.5-89.49; B = 79.5-84.49; C+ = 74.5-79.49; C = 69.5-74.49; D = 59.5-69.49; F = 0-59.49. Curving is at the discretion of the professor.

Copyright 2020 Elizabeth B Torres
